



CRITICAL THINKING ACTIVITY: THE METHANE CYCLE

OBJECTIVES: Students will:

- ✚ Understand the structure and properties of methane;
- ✚ Understand the role of microorganisms in the cycling of methane;
- ✚ Evaluate the role of humans in the methane cycle;
- ✚ Use scientific inquiry methods to evaluate the future role of methane in climate change.

PROCEDURE: Students will use the information from the readings and the discussions held in class to respond to questions related to several scenarios that could arise within the environment regarding methane directly as well as the indirect effects of methane. Students may work in pairs on their response or alone and may refer to the text provided to support their responses. Where possible, students should create a visual interpretation of the event to corroborate their response as well.

- ✚ **SCENARIO 1:** As anthropogenic emissions of methane cause temperature to increase, the top layer of permafrost that temporarily thaws in summer is thawed to a greater depth. How would you expect this increased depth of the seasonally thawed layer to increase *GHG* emissions?
- ✚ **SCENARIO 2:** When the seasonally defrosting layer is not covered by water, the anaerobic microbes in that region cannot survive. Instead, bacteria, that produce CO_2 , take over in the decay process. Either way, the decomposition of decaying material in the permafrost is part of a feedback mechanism that effects the environment. Is this feedback loop positive or negative? Illustrate your ideas and explain why.
- ✚ **SCENARIO 3:** With increases in agricultural activity, the amount of methane produced from crops and livestock is larger than ever before in human history. Would you consider the recent emissions of methane to be natural, man-made or combination of the two? Why?

Teacher Sheet 2

- ✚ **SCENARIO 4:** The addition of CH_4 into the atmosphere might lead to increased levels of water vapor in the atmosphere, which could then add to the global rise in temperature. How could this happen and why?
- ✚ **SCENARIO 5:** Methane clathrates form under conditions of high pressure and low temperatures. Where do these conditions exist? How might increasing global temperatures change the distribution of these conditions required for the formation and stability of methane clathrates? What could the results be and why?
- ✚ **SCENARIO 6:** When hydroelectric dams are constructed, the land upstream is flooded, burying organic material. How would these conditions affect the release of greenhouse gases? Why? Which gases?

EXTENSIONS:

WRITING TO PERSUADE: The disparity between population size and methane emissions is large, but very difficult to remedy without altering the lifestyle of the greenhouse gas emitters. As a written exercise only, pick one source of CH_4 emissions and argue in support of a 50% reduction in emissions from that source. You should be able to explain:

- ✓ The source
- ✓ How you propose to reduce emissions
- ✓ The possible impact on lifestyles and the economy
- ✓ How the reduction would benefit the slowdown of emissions of CH_4 .

ENGINEERING CONNECTION:

- ❖ Design a method of transportation that runs solely on methane as either a gas or a liquid. Include a detailed description as well as a visual.
- ❖ Design a way to capture methane as it seeps from wetland soils and use it to produce electricity. (Hint: Check out micro turbines, and anaerobic digesters.)